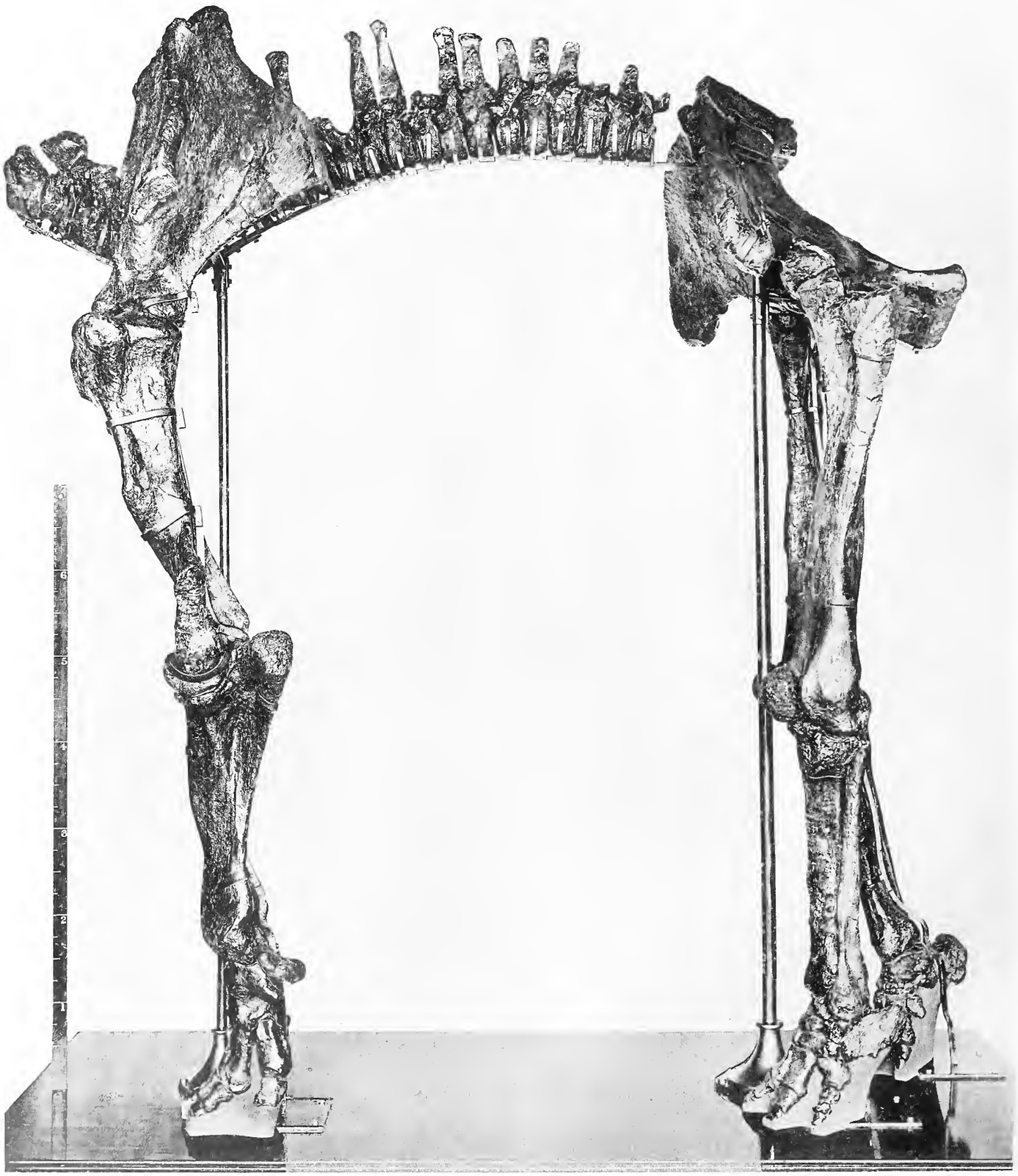

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Elephas antiquus Falconer.

ON A SPECIMEN OF *ELEPHAS ANTIQUUS* FROM UPNOR

BY

THE LATE CHARLES WILLIAM ANDREWS, D.Sc., F.R.S.

WITH FURTHER NOTES ON THE TEETH AND SKELETON

BY

CLIVE FORSTER COOPER, M.A.

SUPERINTENDENT OF THE UNIVERSITY MUSEUM OF ZOOLOGY, CAMBRIDGE

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PREFACE

Charles William Andrews, who entered the Geological Department on the 3rd November, 1892, and won for himself the highest reputation as a student of extinct vertebrata, died on the 25th May, 1924. It has been one of the greatest privileges of my short term of office to superintend the mounting of the great skeleton extracted by my late friend and colleague from the river gravels at Upnor, near Rochester, in Kent. The present volume may perhaps be taken as completing the Department's tribute to his memory.

Deprived as the Department was of the services, not only of Dr. Andrews, but of its other distinguished authority on fossil vertebrates—Sir Arthur Smith Woodward—it would scarcely have been possible either to have finished the mount or to have produced the memoir by this time had it not been for the friendly assistance of Mr. C. Forster Cooper. Though it has been for him a labour of love, that does not make this expression of gratitude any less sincere.

Dr. Andrews' account of the specimen runs from page 1 to page 18, and contains, just as left by him, the description of all the skeleton except the vertebral column, pelvis, and teeth. Those portions are described by Mr. Forster Cooper. The black-and-white illustrations to Dr. Andrews' section are by Miss Gertrude M. Woodward; Mr. Forster Cooper has made the drawings for his own contributions. The photographs of the mounted skeleton were taken in the difficult surroundings of a crowded and cross-lit public gallery by the Museum Photographer, Mr. H. G. Herring.

Since the title-page of this Memoir bears the name *Elephas antiquus* it seems advisable to point out the sense in which this is used. The name first appeared in 1847 attached with a ? to certain figures of molars on plate 14 B, and of a skull on plate 42, of Falconer's "Fauna Antiqua Sivalensis." It next occurred as a simple list name in a synoptic table accompanying Falconer's paper on Mastodon and Elephant in Great Britain (1857). Then in the second half of that paper, posthumously published in 1865, Falconer explained that everything called by him *E. antiquus* in the "Fauna Antiqua Sivalensis" was really *E. meridionalis,* while all figures bearing the name *E. meridionalis* belonged to *E. antiquus.* The facts

revealed by Charles Murchison in his edition of Falconer's Memoirs (1868, vol. I, pp. 442 and 443, footnotes) do not seem to affect the nomenclature.

The addition of a ? to the name in "Fauna Sivalensis" may be held to deprive it of any status, and this is fortunate, since otherwise *E. antiquus* 1847 would disappear as a synonym of *E. meridionalis* Nesti 1825. The name *E. antiquus* was legitimated in 1865, when, definitely and without ?, it was transferred to the figures erroneously named *E. meridionalis* in "Fauna Sivalensis," notably the molars on plate 14 A. It is in that sense that the name *Elephas* (*Euelephas*) *antiquus* was used in Falconer's Memoirs edited by Murchison (1868, vol. II, p. 176), and in that same sense it has subsequently been adopted by authors.

It remains to point out that no holotype has ever been fixed, and in so variable a species this omission introduces a fresh source of possible confusion. It is, however, not thought advisable to repair the omission in the present work, since students of the Proboscidea are awaiting the imminent publication of a complete revision of the nomenclature, with the needful selection of types, from the pen of Professor Henry Fairfield Osborn.

The details of the papers referred to (by Author's name and date) here and throughout the Memoir are given on p. 25. The contractions of titles of periodicals follow, in the main, the World List of Scientific Periodicals.

In his Introduction, Mr. Forster Cooper has acknowledged the help received from several of those engaged from first to last on the installation of the skeleton and the preparation of the Memoir. My own high appreciation of the services of all concerned has been expressed elsewhere (1927), but I may be permitted again to record the thanks of the Trustees and of this Department to Dr. W. Rushton Parker, not only for his generosity, but for his patience, and to express my personal thanks to Mr. A. T. Hopwood for his constant help with the mounting and with the editing.

F. A. BATHER.

Department of Geology,
British Museum (Natural History),
6th February, 1928.

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INTRODUCTION

Owing to increasing ill-health the late Dr. Andrews was unable to complete his account of the specimen of *Elephas antiquus* which had been discovered at Upnor. Some time ago Dr. F. A. Bather, Keeper of the Department of Geology in the British Museum, was kind enough to ask me to prepare Dr. Andrews' account for the press and to describe such parts of the skeleton as were still undone.

After I had gladly undertaken to finish my late friend's work I learnt that, through the great generosity of Dr. Rushton Parker, the specimen was to be mounted for exhibition, and it seemed very fitting that a figure of the animal as finally mounted should form the frontispiece to Andrews' paper. The time involved in preparing the skeleton and in making the complicated mount has caused some delay in the publication of this paper, but that such delay was worth while is evident from an inspection of the striking exhibit which is the outcome of Dr. Rushton Parker's benefaction. As now mounted the specimen shows that the Upnor Elephant is one of the largest of all the known forms, and that, in spite of the absence of the skull, the right fore-limb, and the ribs, it is still probably the finest and most complete skeleton of *Elephas antiquus* in existence; and, from the great rarity of associated bones of this species, it is one of very great scientific value as a standard of comparison.

It is with great pleasure that I acknowledge the assistance of Mr. L. E. Parsons, Preparator in the Geological Department, who not only took part in the actual collection of the bones as Dr. Andrews has already recorded, but who also has been responsible for the preparation and mounting of the specimen for exhibition. To him, therefore, the credit of this admirable piece of work is due. Nor should the preliminary work of Mr. W. Worgan and Mr. W. Mitchell, the joiners of the Department, pass without notice; no one who has had experience in the mounting of fragile bones of the size of those in this elephant will fail to recognise the skill and care required for the design of the necessary wood cradles and other preliminary supports which are needed before the final ironwork can be placed in position. During my visits to the Museum for the purpose of superintending the mounting of this specimen I have also had assistance and advice from three

friends: Mr. A. T. Hopwood, Assistant in the Department, Professor D. M. S. Watson, and Professor H. F. Osborn; the last-mentioned examined the mount during a visit in 1926.

I should like also to place on record my own many obligations to my friend the late Dr. Andrews, under whose guidance I made, in Egypt, my first palaeontological expedition, and to whose long and uninterrupted friendship I have been deeply indebted.

C. FORSTER COOPER.

THE UPNOR ELEPHANT

ACCOUNT OF THE FIND

THREE or four years before the war a party of Royal Engineers, while digging trenches for practice on the banks of the Medway at Upnor, opposite Chatham Dockyard, cut through a number of large bones, some of which, together with a large tusk, were completely destroyed. Operations were then suspended, and no further notice at that time seems to have been taken of the discovery. In 1913, Mr. S. Turner, of Luton, while searching for flint implements in this locality, picked up some pieces of bone which he fortunately sent to the British Museum for identification. One of these bones was recognized as being a carpal bone of an elephant of exceptionally large size. It was then decided that a careful examination of the spot was desirable, and towards the end of the autumn this was made. It then became clear that much of the skeleton was still imbedded in the clay, and a few bones, including an axis vertebra of gigantic size, were collected. The year being already far advanced and the weather bad, operations were suspended, and for various reasons were not resumed till the summer of 1915. Then the military authorities having granted the necessary permission, the excavation was resumed, and continued until there seemed to be no hope of further discoveries. The extraction and preservation of the bones were carried out, under my supervision, by Mr. L. E. Parsons, who lived near the spot for nearly three months and displayed great skill in the work. This was rendered exceptionally difficult by the very fragile character of the bones which lay so near the surface that they were penetrated by the roots of the bushes and other vegetation growing over them, and were riddled by worm-burrows. The dampness of the situation also added to the difficulties. The results, however, have amply repaid the labour involved in the work.

The method by which the fragile bones were extracted from the tough clay may be of some interest. The upper surface and edges of a bone were first exposed as much as possible without danger of breakage. Then the specimen was enveloped as far as possible in a covering of strips of coarse canvas dipped in plaster of Paris; when this casing had thoroughly hardened, the bone was turned

over and the other side cleared from matrix so far as seemed safe. Then this side was covered with canvas and plaster, the wrappings overlapping those of the opposite side so that the whole bone was eventually enclosed in a case which set very hard, and even if it did not prevent some fractures in the course of transport, it retained the fragments in their relative positions.

The beds in which the bones were found were deposited by the river against a low cliff consisting of chalk with a capping of Thanet Sands. The section near the cliff face is :

	ft.	ins.
(1) Sandy clay passing into	3	6
(2) Current bedded sand	1	4
(3) Clay with rounded pebbles at the top	0	6
(4) Whitish grey sand, passing into	0	9
(5) Yellow clayey sand with pebbles at the bottom	1	0
(6) Clay parting with flints at the bottom	0	6
(7) Sharp gravel with angular and rounded flints (flakes) thickening towards the S.S.E. .. .. .. 6 in. to	1	6
(8) Clay with much race, numerous flints (rounded and angular), sand, ironstone passing down to clay with large flints. The bones occurred at the bottom of this layer	5	0

DESCRIPTION OF THE LIMBS

Fore-limbs.

The fore-limbs are represented by a left scapula; a left humerus, wanting most of the head, the tuberosities and the front of the upper part of the shaft; the upper articular end of the right humerus; the left ulna, wanting part of the shaft; a complete right radius and the greater part of the left; and most of the bones of the fore-foot on one side or the other except the cuneiform and unciform.

The Scapula.—This bone is preserved on the left side only. It is much crushed, the spine being bent backwards over the post-scapular fossa. The upper angle is not quite complete, and a considerable portion of the posterior angle is wanting. The form of the glenoid surface is most nearly like that of *E. africanus;* the coracoid tuberosity is rather more developed than in that species, but less than in *E. maximus;* it is much as in *E. primigenius*. Between this tuberosity and the anterior border of the glenoid cavity there is a deep pit, such as also occurs in *E. africanus*. A similar pit is also seen in the glenoid portion of a large scapula (B.M. Geol. Dept. 21680) from Grays, probably belonging to *E. antiquus*. That specimen seems to have belonged to an individual as large as this now described; the length of its glenoid cavity is 256 mm., its width 165 mm., so, though not so long, it is wider than our specimen. The glenoid surface of another very large scapula (B.M. Geol. Dept. 33404), dredged off Happisburgh, measures 235 mm. in length and 120 mm. in width; in this the length of the surface is greater in proportion to its width than in our specimen; it may belong to *E. meridionalis*.

The anterior border seems to have been nearly straight, as in *E. maximus* and *E. primigenius*, while in *E. africanus* it is moderately convex. So far as can be seen the metacromium is situated low down, as in *E. africanus*.

The dimensions of the scapula are:

	mm.
Height to top of spine	1170
Greatest width at glenoid end	364
Greatest length of glenoid cavity	290
Greatest width of glenoid cavity	158
Width of neck	324

The Humerus.—The humerus is an enormously massive bone, being apparently stouter in proportion to its length than in *E. maximus*, *E. africanus*, and *E. primigenius;* the upper end, so far as can be seen on the imperfectly preserved right side, was much like that of *E. primigenius*, presenting no special peculiarity. The chief difference between this humerus and that of *E. africanus*, *E. maximus*, and *E. primigenius*, with which it has been compared, is that the trochleae are less

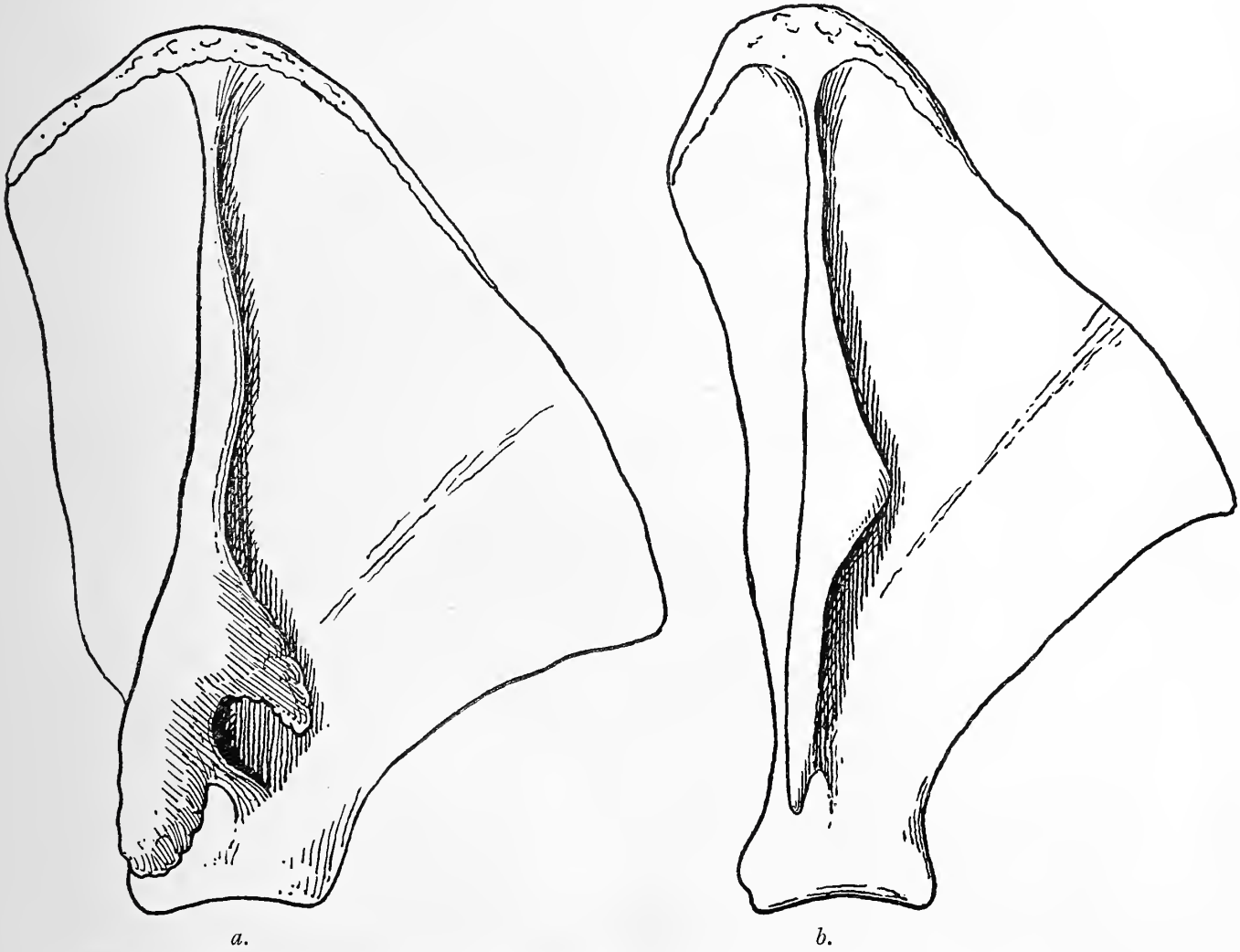
cylindrical, widening gradually from the intertrochlear groove towards their outer and inner edges respectively. The distal end of a great humerus dredged off Happisburgh (B.M. Geol. Dept. 33396), though much abraded, seems to have been

FIG. 1.—Left scapula of the Upnor elephant. $\frac{1}{7}$ nat. size.

similar. The greatest width of the distal expansion of that specimen is about 395 mm., or 45 mm. wider than the Upnor specimen. The width of its trochlear surface is 286 mm.

The anterior face of the bone above the articular surface is gently concave from side to side, as in *E. africanus* and *E. primigenius*. The deltoid ridge seems to

have been situated as in *E. africanus*. The distance from the lower border of the articulation to the upper angle of the supinator crest is about one-third of the total length of the bone, nearly as in the modern elephants.



a. *b.*

FIG. 2.—Left scapulae of the African (*a*) and Indian (*b*) elephants for comparison with that of *E. antiquus*. $\frac{1}{7}$ nat. size.

The dimensions of the humerus are :

	mm.
Greatest length (to top of the articular head)	1290
Greatest width at lower end	350
Least diameter of shaft	167
Width of the trochlear articular surface	306
Length from the upper end of supinator ridge to distal end ..	450
Width at upper end of supinator ridge	332

The Radius.—The upper end of the radius is much like that of the radius of *E. maximus;* its anterior border is nearly straight, and the outer end of the humeral surface terminates in a point on the outer edge of the outer lobe of the humeral surface of the ulna. The inner surface uniting with the inner lobe of the ulna is rounded. The radial surface for the inner trochlea of the humerus seems to be relatively larger than in the recent elephants. It is slightly concave from before backwards and makes an angle of about 130° with the surface for the outer trochlea, which also is slightly concave from before backwards. On the posterior face of the shaft is a large roughened boss of bone fitting into a corresponding fossa on the front of the ulna. The shaft of the radius is slender in its upper third, then it widens outwards towards the distal end, terminating in a club-shaped mass bearing the surfaces for the scaphoid and inner part of the lunar. This distal expansion seems to be relatively larger than in the recent elephants. The shaft and distal extremity are too much crushed for useful comparison with the radii of other species.

The approximate dimensions of the right radius are :

	mm.
Length	990
Width of upper articulation from side to side	175
Width of upper articulation from before back	108
Greatest width at the distal end	197

The Ulna.—Only the left ulna was found. This was nearly complete, wanting only a portion of the shaft immediately above the distal articulation, part of which is likewise missing. Since, however, the right radius is complete, the ulna can be restored with confidence, at least so far as its length is concerned.

The whole bone is remarkable for its great massiveness in proportion to its length ; in this respect it seems to surpass the ulnae of other species of *Elephas* and approximates to the conditions seen in some species of *Mastodon.* Its apparent massiveness may perhaps be partly accounted for by the crushing that the bone has undergone. Falconer and Leith Adams have both commented on the relative stoutness of the limbs of *Elephas antiquus ;* probably it is the natural result of the enormous bulk attained by this species.

The olecranon process is very large ; it terminates in a rugose tuberosity which rises a little above the upper angle of the humeral articulation and turns a little outwards ; its inner angle is broken away. The upper limb of the articular surface for the humerus is not very strongly concave from above downwards, and, as usual, is slightly convex from side to side. The outer of the two lower limbs of the humeral articulation is considerably smaller than the inner, and is much as in *E. maximus.* As noted above, the articular surface for the humerus formed by the united radius and ulna must have been nearly straight in front ; it is gently convex in the middle and slopes away from the median ridge towards its inner and outer borders in accordance with the form of the distal articulation of the humerus described above. Beneath the articular surface the anterior face of the bone is

occupied by a deep fossa for the reception of the upper end of the radius : this fossa seems to be deeper than in recent forms. Beneath this fossa the anterior face of the ulna is concave from side to side, the concavity being bounded by sharp ridges which run up to the outer and inner lobes of the articulation for the humerus. On the whole, the radius and ulna together are very similar to those of *E. africanus*, and also to those of *E. antiquus recki*.

The collection at the British Museum includes the upper half of an ulna from Grays as large as that now under description. This specimen has been referred to *E. antiquus*, but differs considerably from the ulna ot our specimen. Thus the outer lobe of the articular surface for the humerus is very small, so that probably the upper end of the radius was correspondingly large in order to complete the articular surface for the outer trochlea of the humerus, at any rate the fossa for the upper end of the radius is very wide. The inner lobe of the articular surface is very large. The dimensions of this Grays specimen (19838) and of the Upnor specimen are :

	Grays. mm.	Upnor. mm.
Width of the articular surface for the humerus	268	274
Width of the outer lobe of surface for the humerus ..	72	85
Length of the same (measured from the angle between it and the inner lobe)	93	135
Width of the inner lobe of the articular surface for the humerus	131	117
Length of ditto	153	136

From these it will be seen that the outer lobe is much larger in the Upnor specimen than in 19838, while the inner is smaller. The difference in these two ulnae is so considerable that if the Grays specimen is correctly determined as *E. antiquus*, then the Upnor animal must belong to another species or sub-species, unless the range of individual variation in these bones is exceptionally great.

The Fore-foot.

Of the fore-foot the following bones are preserved: scaphoid (right and left), lunar (right and left), pisiform (left), trapezium (right and left), trapezoid (right and left), metacarpal I (right and left), metacarpal II (right), metacarpal III (right and left), metacarpal IV (left and part of right), phalanges and sesamoids.

The Scaphoid (Pl. III, fig. 1*a*).—In this bone the radial facet is nearly flat. It seems to be less inclined to the horizontal plane than in *E. primigenius* (Pl. III, fig. 1*b*) and *E. maximus* (Pl. III, fig. 1*c*), and is more like the corresponding surface in *E. africanus* (Pl. III, fig. 1*d*). In outline it is about two-thirds of a rough circle, the chord marking the angle between it and the upper lunar facet (*ul.*) ; this angle is a little greater than a right angle. The upper lunar facet (*ul.*) is nearly a

semicircle. The facets for the trapezium, trapezoid, and magnum form a continuous curved surface as in the Maltese specimens described by Leith Adams. This articular surface does not extend nearly so far up the outer face of the bone as in *E. primigenius* and *E. africanus*, or even as in *E. maximus* (see Pl. III, figs. 1*b*, 1*c*, 1*d*) ; the surface of the magnum seems to have been a small one. The lower lunar facet (*ll.*) makes a right angle with that for the trapezoid (*tz.*) ; it is deep, particularly towards the anterior border of the bone. In *E. antiquus recki* it is shown by Dietrich to be longer and narrower, as it also is in *E. africanus* and *E. primigenius*. It is much more similar to the same facet on the scaphoid of *E. maximus*, and indeed the whole lower end of the bone is very similar to what is seen in that species, except that the surface of the magnum is smaller ; in this it approaches *E. antiquus recki*. The posterior border of the bone is nearly straight, much as in *E. africanus* and *E. antiquus recki ;* the whole bone seems to be broader in proportion to its length than in any other species, especially at its upper end. Probably in this and the other bones of the foot the range of individual variation is considerable.

The dimensions of the scaphoid are :

	mm.
Greatest length	169
Greatest width of proximal end	106
Greatest width of distal end	138
Length of long axis of radial facet	78
Length of short axis of radial facet	53
Length of trapezoidal facet	120

The Lunar (Pl. III, figs. 2*a* and 3*a*).—In this bone the facet for the radius (right) occupies nearly the whole upper surface ; it is concave from before backwards posteriorly and concave in the same direction in front. The small ulnar facet (*u.*) is oval in outline and truncates the antero-external corner of the bone, making an angle of about 90° with the radial facet. In *E. primigenius* (Pl. III, fig. 2*b*) the angle is more obtuse, while in *E. africanus* (Pl. III, fig. 2*d*) it looks more backwards and is relatively larger. The outer border of the ulnar facet forms a continuous line with the outer border of the radial facet, and is not sharply deliminated by a notch as in *E. antiquus recki*, according to Dietrich's figure (1924, pl. iii, fig. 9).

The ventral (distal) surface for the magnum is convex from before backwards in front and concave in the same direction behind. In front the lunar is considerably wider than the magnum upon which it rests, so that on the inner side it slightly overlaps the trapezoid, and on the outer the cuneiform. Posteriorly it narrows considerably, so that an area of the postero-internal side of the magnum is left free for articulation with the scaphoid, and at its postero-external angle it is overlapped by the cuneiform. The interlocking of the central bones of the carpus is thus somewhat complex ; the upper surface of the magnum being completely covered in front by the lunar, which extends on to the trapezoid and unciform,

while the magnum behind is in contact with the scaphoid, lunar, and cuneiform. The massive posterior portion of the lunar bears a prominent mass of bone projecting behind the articular facet for the magnum.

The dimensions of the lunar are :

	mm.
Greatest width from before back	175
Greatest width radial facet from before back	133
Greatest width radial facet from side to side	134
Greatest depth of anterior face	94
Greatest width of anterior face from side to side	158

The Cuneiform (Pl. IV, fig. 1*a*).—No specimen of this bone was found with the Upnor skeleton. The British Museum collection contains a large imperfect fore-foot from Grays, probably belonging to *E. antiquus*, and of about the same size as our specimen ; the cuneiform and unciform (both regd. 18246) of this foot have been used in making the restoration of the fore-foot for the mounted skeleton.

The Pisiform (Pl. IV, fig. 2).—The pisiform is a strongly curved bone terminating distally in a roughened tuberosity. The facet for the ulna is very small and narrow, and it makes an oblique angle with the facet for the cuneiform. This tongue-shaped surface is long, extending over nearly a third of the length of the bone. The form and arrangement of the facets is very unlike what is seen in *E. antiquus recki*, *E. maximus*, and *E. africanus*, but is somewhat similar to what occurs in the pisiform of a Mammoth from Klinge figured by Dietrich (1916, pl. v, fig. 8).

The dimensions of the pisiform are :

	mm.
Greatest length	188
Greatest width at upper end	97
Greatest length of the facet for the cuneiform	90

The Trapezium (Pl. IV, fig. 3*a*).—This bone is preserved on both sides, but that from the right is in much the better condition of the two. The angle between the facets for the trapezoid (*tz.*) and for the second metacarpal (*mc.* 2) is a very obtuse one, so that they are not far from lying in the same plane. In *E. maximus* this angle is only a little greater than a right angle ; in *E. africanus* it is more obtuse, but not so much as in our specimen. The facet for the scaphoid is smaller than that for the second metacarpal, and it makes about a right angle with the facet for the trapezoid. The distal articulation for the first metacarpal is oval and slightly convex ; in *E. africanus* it is nearly flat. In *E. antiquus recki* the whole bone seems to be proportionately shorter and stouter.

The dimensions of the trapezium are :

	mm.
Greatest height	117
Greatest width at upper end	92
Greatest width at lower end	96
Greatest thickness	58

The Trapezoid (Pl. IV, figs. 4*a*, 4*b*).—The proximal surface of the trapezoid, which forms the facet for the scaphoid, is nearly flat, and is triangular in outline. Probably a very narrow strip of the anterior portion of the edge next to the magnum was overlapped by the lunar, but no special facet is developed. The facet for the trapezium is deep in front and narrow behind, a deep pit occurring at the junction of the broad and narrow portions. The facet for the magnum is nearly divided into a deep anterior portion and a narrow posterior one. The distal facet for union with the second metacarpal is gently convex in all directions; it is narrow posteriorly, but widens out towards the front, where it covers the whole width of the upper end of the metacarpal II, which is thus entirely shut out in front from any contact with the magnum. In most elephants, as will be shown below, the magnum has an articulation with the second metacarpal extending from the front to the back of the bone.

The dimensions of the trapezoid are :

	mm.
Greatest width of the outer (postaxial) border	146
Long diameter of the facet for the scaphoid	112
Width of the inner (preaxial) face	114
Width of outer (volar) face	98
Height of outer (volar) face	8

The Magnum (Pl. V, figs. 1*a*, 2*a*).—This bone is preserved on both sides. Its upper articular surface is almost exactly as in *E. africanus*. In the articulated foot it is completely covered anteriorly by the distal surface of the lunar which projects a little beyond it, both on the outer and inner sides. Posteriorly, as noted above, the lunar narrows so that the postero-internal and postero-external angles of the upper surface of the magnum are left free to articulate with the scaphoid and cuneiform respectively. The surfaces for articulation with the trapezoid and unciform are almost exactly like those occurring in *E. africanus*, but the distal (metacarpal) surface is peculiar. In nearly all the other species in which the magnum is known, the facet for union with the second metacarpal extends to the front of the bone and makes an obtuse angle with the facet for the third metacarpal; it is usually much narrower than this latter, though in one specimen of a magnum dredged up at Happisburgh (perhaps belonging to *E. meridionalis*) the facets for the second and third metacarpals are of nearly equal width and make an angle of about 120° with one another. In our specimen (Pl. VIII, fig. 2*a*, *mc*.2), the facet for the second metacarpal is confined to the posterior portion of the bone, while that for the third widens anteriorly, so that there it occupies the whole width of the bone, and when looked at from the front the magnum seems to have to carry the third metacarpal only and to have no contact with the second.

The only other specimens I have been able to find showing this arrangement of the facets belong to undetermined Siwalik (probably Pliocene) species. One of these is a single bone (17457), the other is included in a carpus (M 3195) figured by Falconer in *Fauna Antiqua Sivalensis* (Pl. 50, fig. 1). In another carpus

(M 3196), also figured by Falconer (Pl. 50, figs. 2, 2*a*, 2*b*), the facet for the second metacarpal extends the whole width of the bone. In *Elephas antiquus recki* also this facet extends the whole width of the bone, but narrows towards the front; the same is the case in a very large magnum (18224) from Grays referred to *E. antiquus*. If the determination is correct, as from the size of the bone and the locality in which it was found it probably is, it would appear that there may be considerable individual variation in the structure of the foot. In *Palaeomastodon* the facet for the second metacarpal is complete, so that its restriction to the posterior part of the bone seems to be a specialization.

The dimensions of the magnum are:

	mm.
Greatest distance before backwards	174
Width of the surface for lunar behind	127
Width of the surface for lunar in front	117
Greatest width of lunar facet from before backwards	135
Width of surface for third metacarpal in front	94
Height at antero-internal angle	89
Height at antero-external angle	97

Unciform.—No specimen of the unciform has been preserved.

Metacarpals.—The metacarpals are extraordinarily stout and massive. The first metacarpal is preserved on both sides. It is somewhat compressed from side to side and considerably expanded from before backwards at its upper end, having a large pointed prominence projecting considerably behind the facet for the trapezium. This facet is oval in outline, its long axis being antero-posterior; it is gently concave. The distal end of the bone is somewhat enlarged and the articular surface for the phalanx and sesamoid bones is rather more than a quarter of a circle, and extends considerably up the posterior face of the bone. The face of the shaft next to the second metacarpal is concave from above downwards.

The dimensions of the bone are:

		mm.
Length		154
Width of facet for the trapezium from before backwards		175
Width of facet for the trapezium from side to side	about	55
Width of the distal articulation from before backwards		86

The second metacarpal is complete on the right side only. At its upper end it bears three facets, one extending from the front to the back, and in front occupying the whole width of the bone, this is for the trapezoid and is concave from side to side. The second facet, which is for the magnum, is confined to the postero-external side. It is nearly flat and makes an angle of about 105° with the trapezoidal facet. The third facet is a band-like surface beneath the facet for the magnum with which it makes an angle of about 120°; it is for union with the third metacarpal. The shaft is triangular in section, and towards its distal end widens out to bear the broad convex surface for the phalange.

The dimensions of the second metacarpal are :

	mm.
Length	227
Width of upper end from before backwards	120
Width of upper end from side to side	94
Width of the middle of the shaft	84
Width of distal expansion	110

The third metacarpal is the largest ; it is preserved on both sides. Its upper end is nearly entirely occupied by a broad facet for the magnum, gently convex from before backwards and slightly concave from side to side. The remainder of the upper end is occupied by a narrow facet for the unciform extending from the front to the back of the bone and making an angle of about 10° with the facet for the magnum. Beneath the facets for the carpals are those for the neighbouring metacarpals, that for the fourth being deep and sharply defined ; it extends nearly the whole width of the bone. The shaft is stouter than in the second metacarpal, and less triangular in section, and the distal articulation is extraordinarily massive.

The dimensions of the third metacarpal are :

	mm.
Greatest length	246
Width of upper end from side to side	114
Width of upper end from before back	121
Width of the middle of the shaft	100
Width of the distal end	108

The fourth metacarpal is preserved on the right side only. Though shorter than the third it is broader, at least in front. Its upper end is occupied by a gently convex facet for union with the unciform, the only carpal with which it is in contact. This facet is triangular in outline, its anterior border is slightly convex from side to side, the inner is nearly straight, and the outer somewhat concave. Beneath this facet the sides of the bone bear surfaces for union with the adjacent metacarpals. That for the third is the widest and makes an angle of about 115° with the unciform facet, while the narrower surface for the fifth metacarpal is about at right angles to it. The shaft is roughly triangular in section, its anterior face being gently convex from side to side. The distal articular surface consists of a broad convex facet for the phalangeal bone, and behind this a surface for the sesamoids, divided into a large outer and a small inner facet.

On the whole, the third and fourth metacarpals are very like those of the African elephant.

The dimensions of the fourth metacarpal are :

	mm.
Length	216
Width of the upper end from side to side	120
Width of upper end from before backwards	121
Width of the middle of the shaft	108
Width of the distal end	122

PHALANGES.—Except for their large size and massive structure the phalanges present no special peculiarities.

One specimen of the ungual phalanx was found.

HIND-LIMBS.

The hind-limbs are represented by the proximal halves of both femora; the almost complete left tibia, and the distorted distal end of the right tibia; the left fibula, except for three inches or so towards the upper end, and the distal end of the right-hand bone; and most of the bones of the feet on one side or another, except the mesocuneiform.

FEMUR.—Only the proximal halves of the two femora are preserved, the remainder having been destroyed in digging the original trench. The head of the bone is nearly hemispherical, and the neck is very short. On the left side the upper border of the bone running from the neck to the upper angle of the great trochanter is nearly at right angles to the long axis of the bone, so that the upper angle of the trochanter rises very slightly above the level of the outer edge of the articular surface of the head. On the right side the angle of the great trochanter actually rises to the level of the top of the head, and the upper border of the bone is concave. It seems probable that this represents the real shape of the bone, in which case this part of the femur differs widely from those of *E. africanus*, *E. maximus*, and *E. primigenius*, in which the neck is longer and rises more above the trochanter. There is a certain degree of likeness to the femora of some Mastodonts, e.g. *Mastodon andium* (Boule and Thevenin, 1920, p. 56, fig. 22). A femur from Overstrand, Norfolk, possibly that of *E. meridionalis*, differs from our specimen much as the recent species do. The digital fossa is broad and rather shallow; it is bordered externally by a much-thickened wall. There seems to be no trace of the lesser trochanter, and in this our specimen resembles the femur of *E. africanus* rather than that of *E. maximus*. The whole of the upper part of the bone is so compressed that its original form is difficult to make out. The distal part is quite unknown, but has been restored for mounting mainly on the lines of *E. africanus*.

The dimensions of the specimen are:

	mm.
Diameter of the head (inner to outer side)	214
Width of neck	190
Greatest width of upper end of bone	467
Length as restored	1545

TIBIA.—The left tibia is nearly complete, but the right is represented only by the lower end, which is much cracked and distorted.

At the massive proximal end the facet for the inner condyle of the femur is nearly circular in outline, and is somewhat deeply concave, especially posteriorly. The outer facet is narrower from front to back than from side to side, but is relatively

wider than in the recent elephants ; it is concave and slopes away towards the outer side, which is at a considerable lower level than the inner facet. In the form of this facet our tibia differs considerably from that of the Mammoth and resembles a tibia ascribed to *E. antiquus* by Leith Adams, 1874, pl. xix, figs. 11, 11*a*, 12, 12*a*). On the other hand, the distal articulation seems more like that seen in the Mammoth, particularly in the straightness of its anterior border. In our fossil, however, the borders are somewhat abraded, so that it is difficult to be sure of its exact shape. The astragalar surface is wider from before backwards than in any specimen with which comparison has been made, but it comes nearest to what occurs in *E. africanus*. The concavity of the astragalar facet is continuous and not very strongly marked. The angle which the nearly flat fibular face makes with that for the astragalus is about 130°. The internal malleolus is relatively larger than in either of the recent species. The shaft is so much crushed that it does not admit of exact comparison, but on the whole seems to have been more slender than in a tibia (B.M. 40134) ascribed to *E. antiquus* or than in the Mammoth.

The dimensions of the left tibia are :

	mm.
Greatest length	1020
Greatest width of proximal end, from side to side	281
Greatest width of proximal end, from before backwards	183
Greatest width of distal articulation	230
Width of surface for the astragalus	153
Width of the middle of the shaft .. .. about	150

The distal end of the right tibia measures 250 mm. across, but this is exaggerated by cracks and adherent matrix.

Fibula.—The fibula of the left side is complete except for two or three inches towards the upper end of the shaft ; that on the right side is represented by the distal expansion only. The bone widens out a little towards its upper end and bears a well-defined facet for union with the tibia. The distal end is massive and bears the usual facets for the tibia, astragalus, and calcaneum. The form of these surfaces is much as in *E. africanus*.

The dimensions of the fibula are :

	mm.
Length	930
Width of distal end	165

Hind-foot.

Of the hind-foot the following bones are preserved : astragalus (right and left), calcaneum (right and left), navicular (right), cuboid (right and left), entocuneiform (right), ectocuneiform (right and left), metatarsal II (right and left), metatarsal III (left), metatarsal V (left).

ASTRAGALUS.—The astragalus (Pl. VI, figs. 1*a*, 2*a*) is very low and broad as in *E. antiquus recki;* the tibial facet is scarcely perceptibly concave from side to side. On the whole, the bone is much like that of *E. maximus* and *E. primigenius*, and differs from the astragalus of *E. africanus* in the greater development of what may be called the neck, which carries the facet for the navicular; in *E. africanus* this neck is practically absent on the outer fibular side of the bone. The postero-internal angle extends further back than in *E. primigenius* and *E. africanus;* it terminates in a large boss of bone continuous with that on the inner side. In this respect the astragalus of *E. maximus* is most similar. The sustenactular (ental) facet is continued further back than in *E. primigenius*, *E. africanus*, and *E. antiquus recki*, being much like what is seen in *E. maximus*, the astragalus of which on the whole most nearly resembles our specimen. The ectal facet is at a higher level than the sustenactular; these two facets are almost equal in size, while in *E. antiquus recki* the ectal is considerably the larger, as this seems to be the more usual condition. The navicular facet makes an angle a little greater than a right angle with the sustenactular facet and the angle between a line drawn at right angles to the chord of the tibial facet, *i.e.* in the direction of the long axis of the tibia, and a line at right angles to the navicular facet (Dietrich's normal angle of the joint) is about 120°–125°. If this angle is correct, and it is by no means easy to get certain results in making such measurements, then it would seem that the long axis of the hind-foot is not so nearly in the same straight line with the long axis of the tibia as it is in *E. antiquus recki*, and still less so than in *Dinotherium*. This, in an animal of such massive proportions, is not what one would have expected.

CALCANEUM (Pl. VII, figs. 1*a*, 2*a*).—The calcaneum is preserved on both sides; it is a very heavily built and massive bone. The tuber calcis is short and deep, and the rugosities that terminate it are very strongly developed. Of the facets for the astragalus the ectal is nearly flat, while the triangular sustenactular facet which is at a rather lower level than the ectal, has a gently undulated surface. The groove between these two facets deepens to a pit in the middle of its course. The fibular facet makes an angle of about 110° with the ectal. The facet for the cuboid is concave from before backwards; the chord of this concave surface makes as nearly as possible a right angle with the ectal facet. In *E. primigenius* and *E. maximus* the cuboid facet is slightly concave towards its posterior border; in *E. africanus* the concavity is rather more marked, but still much less so than in our specimen.

The facet for the navicular is nearly circular in outline; it makes an angle of 110° with the sustenactular facet. It most resembles the same facet in *E. primigenius;* in *E. africanus* and *E. maximus* this angle is more obtuse, and the surface relatively more elongated from side to side. The calcaneum of *E. antiquus recki* has much the same proportions as that now described, but in it the ectal facet is much larger than the sustenactular. On the whole, our specimen most nearly resembles the calcaneum of *E. africanus*, except that the fibular facet is smaller.

The dimensions of the calcaneum are :

	mm.
Greatest length	292
Greatest width of surface for the astragalus from above downwards	156
Greatest width of surface for the astragalus from side to side ..	218
Depth of tuber calcis	174
Width of tuber calcis	111

Navicular (Pl. VI, figs. 3*a*, 4*a*).—This bone is preserved on the right side only. It differs only in detail from the navicular of *E. africanus ;* thus on the upper surface the semicircular calcaneal facet is larger and on the distal surface the facet for the cuboid and entocuneiform are more nearly continuous with one another, and make an angle with facets for the meso- and ecto-cuneiform. In this respect the difference from the navicular of *E. maximus* is still greater (Pl. VI, fig. 4*c*).

The dimensions of the navicular are :

	mm.
Greatest width from side to side	185
Greatest width from before back	112
Greatest width of astragalar surface (in a straight line)	148
Width of calcaneal facet	45

The angle between the calcaneal facet and that for the astragalus is about 130°.

This navicular differs in several respects from a specimen from Grays referred by Adams to *E. antiquus* (21642). In this the surface for the calcaneum makes a more obtuse angle with the astragalar surface, and is also larger, being borne on a backwardly directed tongue of bone scarcely indicated in our specimen. The astragalar surface is flatter, and the whole bone thinner (shorter from above downwards) than in our specimen. Distally, except for the tongue-like prominence above referred to, the two are very similar. The Grays specimen measures 186 mm. from side to side, 130 mm. from before back at tongue, and is 47 mm. thick in the middle.

The navicular of *E. antiquus recki* is very similar to that of the Upnor specimen, but the astragalar facet is wider from side to side in proportion to its antero-posterior diameter.

The Cuboid (Pl. VIII, figs. 1*a*, 2*a*).—In outline the cuboid forms nearly an equilateral triangle ; it differs from the cuboids of *E. maximus* and *E. africanus* in having the posterior boss of bone projecting behind the articular surfaces much more developed. The form of the surfaces for the calcaneum and navicular are more as in *E. maximus* than as in *E. africanus*, in which the navicular surface is relatively much smaller. The calcaneal surface is rather more convex from side to side than in *E. maximus ;* in *E. africanus* this convexity is fairly well marked. In the Indian elephant the navicular and calcaneal facets are separated posteriorly for a short distance by a notch or pit ; traces of this occur in our fossil, and also apparently in *E. antiquus recki*, but it is wanting in the African elephant.

In *E. antiquus recki* the cuboid seems to be narrower from side to side in proportion to its antero-posterior diameter, and the long axis of the calcaneal and navicular facets are nearly parallel instead of converging posteriorly.

The distal facets for the fourth and fifth metatarsals are more nearly similar to the same surfaces in *E. maximus* than in *E. africanus*. This is especially noticeable in the surface for the fourth ; in *E. africanus* this is separated posteriorly from that for the fifth metatarsal by a deep pit, not seen in *E. antiquus* or *E. maximus*.

The dimensions of the cuboid are :

	mm.
Length of outer (volar) border	150
Length of cuneiform border	149
Length of osterior border	151
Greatest depth of anterior face	66

The Entocuneiform.—This bone is known from the right side only. At its upper end it has an oval, nearly flat surface, looking upwards and backwards, for the navicular. On the posterior face of the bone beneath the navicular facet is a surface for the mesocuneiform, and there was probably also a distal facet on the inner side for contact with the second metatarsal. Beneath the proximal articulation the bone widens out and bears a tuberous prominence on both its anterior and posterior borders. Distally it then narrows and terminates in a gently convex, nearly circular facet for the first metacarpal, there having apparently been a well-developed hallux.

The dimensions are :

	mm.
Greatest length	89
Greatest width	77

The facets are too much abraded to measure.

Mesocuneiform.—No specimen of this bone was found.

Ectocuneiform.—This bone is most similar to that of *E. africanus*. It is chiefly remarkable for the large size of the rectangular facet for the upper end of the fourth metatarsal. In *E. africanus* this facet is much smaller, and in *E. maximus* very small indeed (Pl. VIII, figs. 3*a*, 3*b*, 3*c*).

The upper surface for the navicular is gently concave from before backwards as usual ; it is much more elongated from before backwards than in *E. antiquus recki*.

The dimensions of this bone are :

	mm.
Greatest antero-posterior diameter	137
Length of anterior face	93
Depth of anterior face	54

The Metatarsals.—The first metatarsal is not preserved on either side, but judging from the distal facet on the ectocuneiform it must have been of fairly large size.

The second metatarsal is the smallest of the rest of the series. Its upper articulation, which is gently convex from before back, is much longer in that direction than from side to side. The whole of the upper end is occupied by the facet for the mesocuneiform except for a small oblique triangular facet which truncates the antero-internal angle, and serves for union with a facet on the middle of the anterior border of the ectocuneiform. The upper end of the bone is much narrower than the lower, which widens out considerably towards the articulation for the phalanx and bears a prominent boss of bone on its preaxial side.

The third metatarsal is considerably larger than the second, being especially wider at its upper end. The proximal surface has a considerable area of contact with the mesocuneiform; in *E. africanus* this contact is very small, and in *E. maximus* is wanting altogether. The greater part of the upper articulation is with the ectocuneiform, which, like the mesocuneiform, is extended towards the outer side so as to form a considerable facet for the next metatarsal, in this case the fourth.

The fourth metatarsal is the largest of the series. Its broad triangular upper end bears two facets, one nearly flat and occupying nearly a third of the area; this is for union with the ectocuneiform; the other facet for the cuboid is convex from side to side, especially towards its outer edge. On either side of the upper end, and joining the proximal articulation approximately at right angles, are facets for union with the third and fifth metatarsals.

The fifth metatarsal, though shorter than the fourth, is thicker and more massive. At its upper end there is a gently concave surface, whose outline forms a segment of a circle rather greater than a semicircle, the chord forming the border next the fourth metatarsal.

In *E. antiquus recki* the third metacarpal is said to have a distinct facet for contact with the mesocuneiform, and as in the Upnor specimen the fourth metatarsal has a considerable articulation with the ectocuneiform. It thus appears that in that form, as in our specimen, there is a considerable degree of alternation between the distal row of tarsals and the metatarsals; this alteration exists in a lesser degree in *E. africanus*, but is not present in *E. maximus*. Possibly this interlocking may be correlated with the great weight of the different forms of *E. antiquus*.

C. W. ANDREWS.

NOTES ON THE REMAINING PORTIONS OF THE SKELETON

The Pelvis.

Although the bulk of the pelvis was recovered it is too much damaged round its borders to allow of an accurate description. It is likely, however, that the restoration is reasonably correct. In general contour and proportions it is similar to that of *Elephas africanus*, except for its considerably greater size.

The principal measurements of the pelvis as restored are :

	mm.
Extreme width across the ilia at right angles to the vertebral axis	1830
Greatest width of ilium	1100
Width between the acetabula	945
Greatest diameter of acetabulum	250
Approximate length of symphysis	570

The Vertebral Column.

The vertebral column was found practically complete, but much weathered. This is very unfortunate, because in some respects it appears to be of a very unusual type, and it would have been interesting to know more accurately the shape of the ridge of the back for comparison with that of *Elephas indicus*, *E. africanus*, and *E. primigenius*, in each of which the shape is distinctive. Nevertheless, since the vertebral column of *E. antiquus* is so little known, the present specimen is of great interest. In the specimen of *E. antiquus recki* figured by Dietrich (1924, p. 8, fig. 3) the vertebral column was even more incomplete.

The number of dorsal vertebrae actually found was twenty ; the specimen has been mounted so as to leave space for two more. The series runs in order from the atlas to the twentieth dorso-lumbar, the missing ones belong, therefore, to the vertebral column just in front of the sacrum.

The atlas and axis are both moderately well preserved, and neither shows any very remarkable characters. The atlas (fig. 3*a*), which lacks the wing on each side, has a somewhat low spine on the neural arch, whose pedicel on each side is pierced by a foramen through which the vertebral artery was transmitted. In a corresponding atlas of *E. meridionalis* (B.M. 36436, fig. 3*c*) this is represented by a deep groove. There are other slight differences of proportion and also in the shape of the articulating surfaces for the condyles of the skull as are shown by the figures. Of the two, the Upnor specimen is a little the larger.

The axis (fig. 3*b*), which likewise may be compared with a specimen belonging to *E. meridionalis* (B.M. 27872, fig. 3*d*), shows again a slight difference in proportions, and, of the two, has a rather more slender neural arch. While both the atlas and axis are each of them a little larger than the corresponding bones of *E. meridionalis*, they are not so to the extent that might be expected in an animal of such remarkable size in the rest of its skeleton.

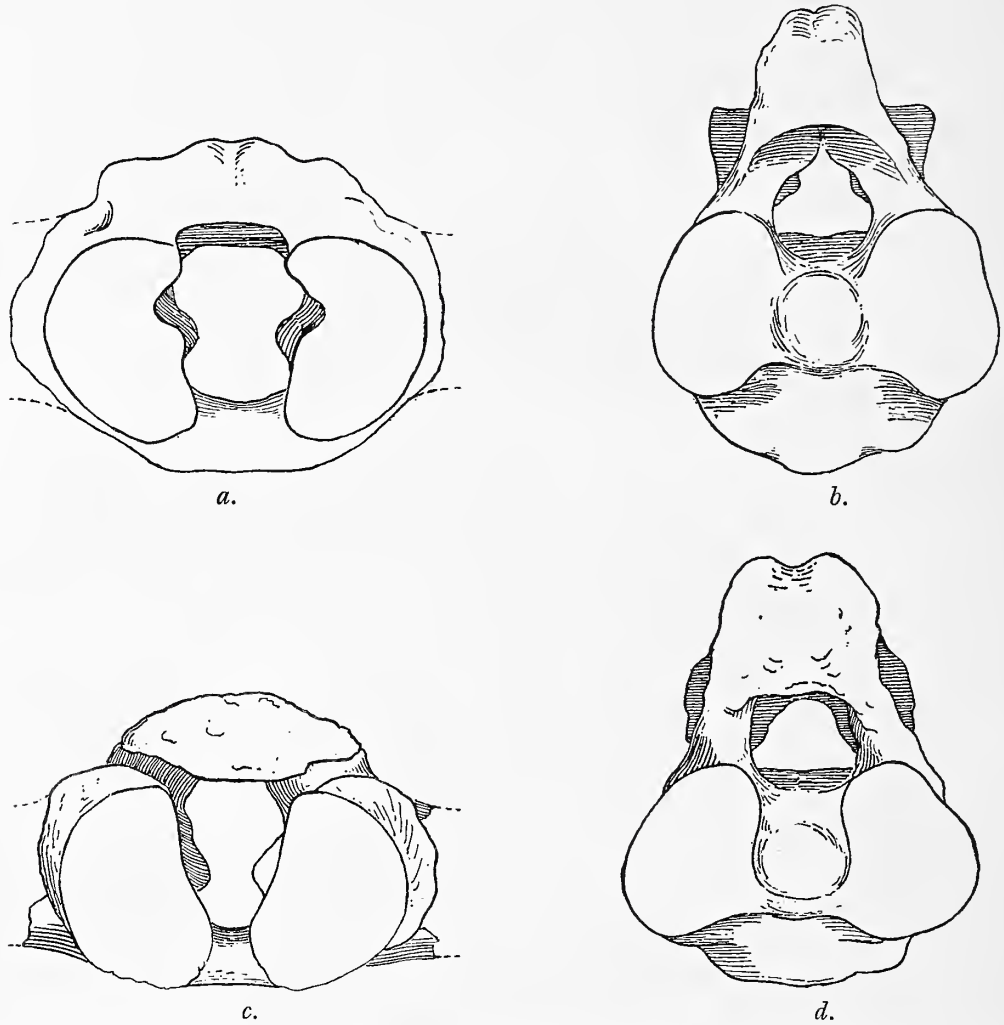


FIG. 3.—Atlas (*a*) and axis (*b*) of the Upnor elephant compared with the corresponding bones of *E. meridionalis* (*c*, *d*). $\frac{1}{6}$ nat. size.

Of the other vertebrae the most striking point is the unusual angle at which the neural spines are placed, both in respect to the individual vertebra and to the backbone itself. There is, in various species, some variation in the curve along the back that is formed by the tips of the neural spines. Dietrich has illustrated diagrammatically these curves for *E. africanus*, *E. primigenius*, and *E. maximus*. From lack of sufficient material the curve for *E. antiquus* has been so far unknown,

nor does the present skeleton, owing to damage, yield absolutely definite information, but, as far as can be seen, it is not unlike that of *E. maximus*, where the top of the spine of the first dorsal vertebra reaches approximately the same height as the top of the scapula, and from this point the spines gradually rise in height to a maximum in the region of the eleventh or twelfth dorsal vertebrae, and thereafter fall away in height gradually down to that of the sacral vertebrae.

The Upnor specimen, however, shows one great difference, not only from *E. maximus*, but apparently from other elephants, in that the neural spines of all

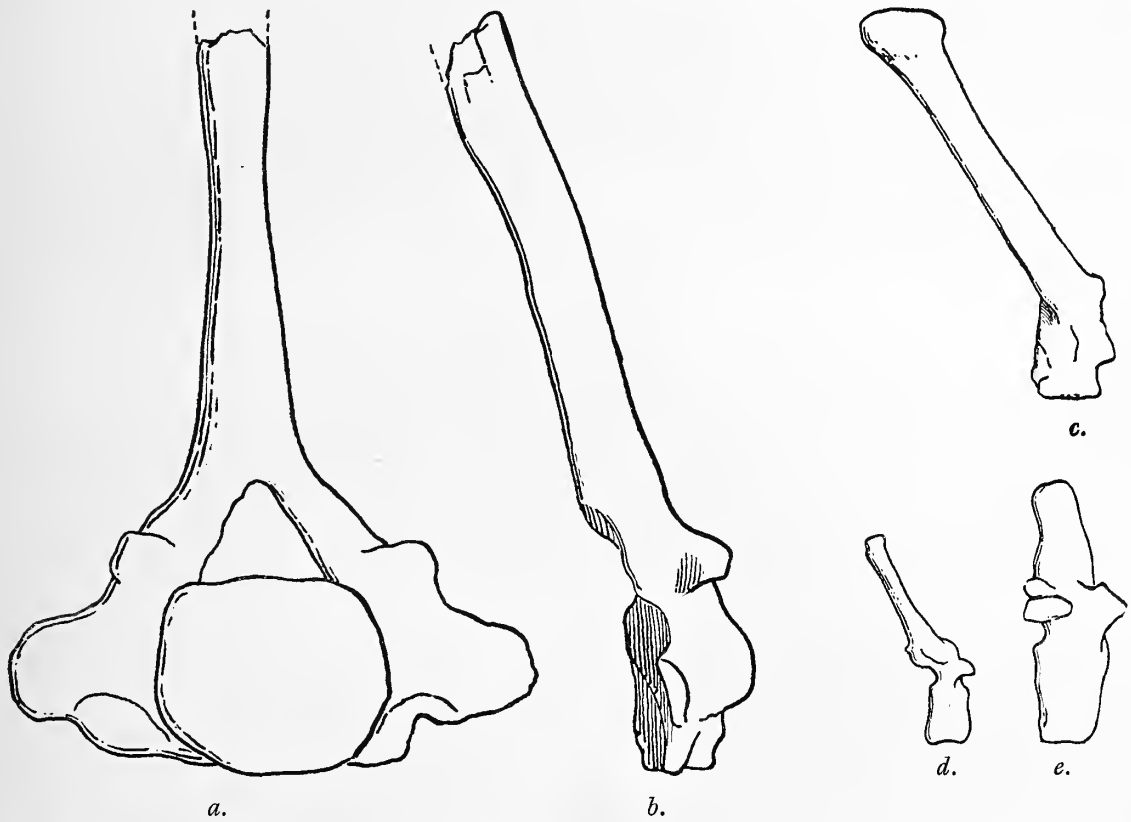


FIG. 4.—(*a*) First dorsal vertebra of the Upnor elephant seen from the front, and (*b*) from the left side. (*c*) The same bone in *E. maximus*. (*d*) Sixteenth dorsal vertebra of Indian elephant for comparison with the same bone in the Upnor elephant (*e*). All $\frac{1}{7}$ nat. size.

the dorso-lumbar vertebrae stand bolt upright at right angles to the longitudinal plane of the vertebra. In other elephants all the dorso-lumbar spines except the most anterior slope backwards at a considerable angle. The condition here is undoubtedly natural, is not due to postmortem changes, and appears to have no parallel. The spines of the vertebrae in this region also show another peculiarity, in that those of the posterior lumbar vertebrae are broad right up to the top (as seen in side view) instead of dwindling down to a point, which is the more usual condition.

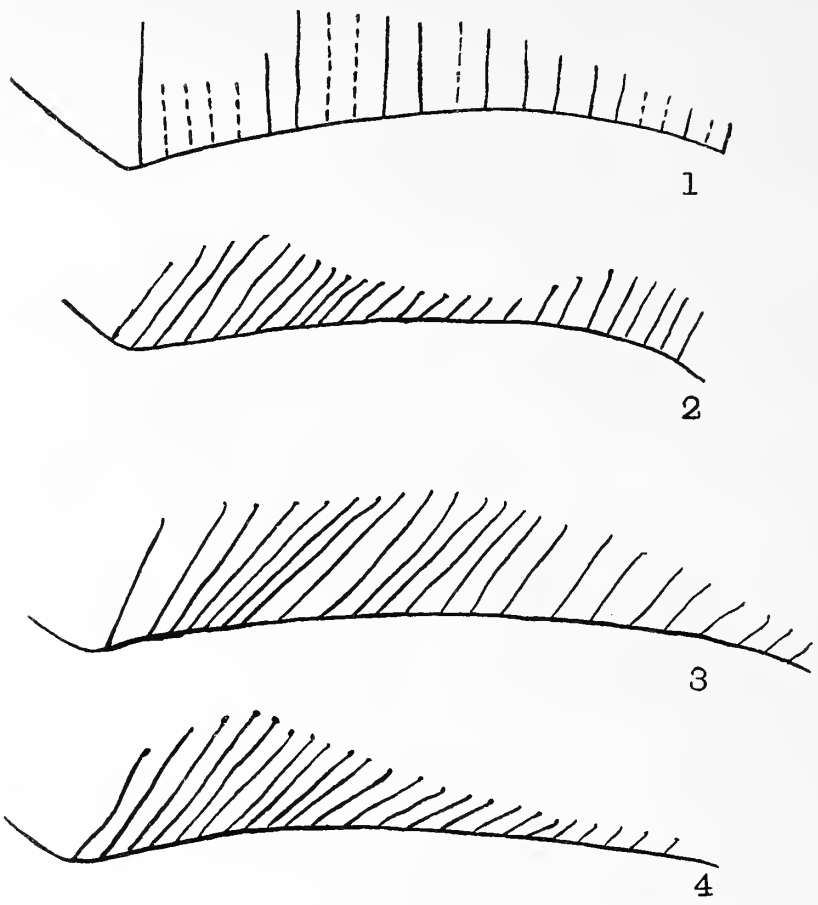


FIG. 5.—Diagrams to illustrate the curvature of the vertebral column, and the position of the neural spines in (1) *Elephas antiquus*, Upnor ; (2) *Elephas africanus ;* (3) *Elephas maximus ;* (4) *Elephas primigenius.* From the first thoracic to the first sacral vertebra. (Figs. 2, 3, 4 after Dietrich, 1924, fig. 3.)

MEASUREMENTS OF CERTAIN OF THE VERTEBRAE AND PRINCIPAL MEASUREMENTS OF THE MOUNTED SKELETON.

	Upnor Specimen.		*E. meridionalis.*	
ATLAS.	mm.	ins.	mm.	ins.
Extreme width of articulating surfaces for condyles of skull	295	11·6	270	10·6
Extreme height of vertebra	285	11·2	280	11·0
Extreme width of articulating surfaces for axis ..	265	10·4	280	11·0
AXIS.				
Width of anterior articulating surface	275	10·8	295	11·6
Extreme height of vertebra	370	14·6	360	14·2

The measurements of the mounted skeleton are compared with those of an unusually large tuskless Indian elephant in the Museum.

	Upnor Specimen.			*E. maximus.*		
	ft.	ins.	metres.	ft.	ins.	metres.
Humerus	4	1	1·24	3	1	0·94
Radius-ulna	3	2	0·955	2	7	0·79
Foot	1	9	0·534	1	2	0·356
Total height of fore-leg	9	0	2·75	6	10	2·09
Femur	5	0	1·52	3	9	1·14
Tibia	3	0	0·915	2	2	0·66
Foot	1	6	0·455	0	10	0·254
Total height of hind-leg	9	6	2·89	6	9	2·05
Height from the top of the scapula to ground	12	1½	3·7	9	6	2·89
Height across the top of the pelvis to ground	11	9	3·58	9	0	2·75
Length of the vertebral column as mounted from the atlas to back of the pelvis	11	1½	3·3	—		—
Height to ground from the top of the spine of the 11th dorsal vertebra (the highest point of the body)	12	7	3·84	—		—
Height from top of scapula	12	1½	3·7	—		—

Teeth.

Of the teeth only a portion of one of the tusks and three molars were preserved.

The tusk is broken off at each end ; the remaining part is evenly curved, 2,240 millimeters in length and 205 in diameter at the thickest part. It is probable that not much has been lost in front.

Of the molar teeth there are two upper ones and one lower. It is not always easy to distinguish with certainty between the second and third molars, but in this case it is probable that all the teeth are the ultimate ones, a right and left upper and left lower third molar. Dr. Andrews so considered them and left a rough note to that effect. He also spoke of them to me as third molars. In favour of this view are the circumstances of the collection of the remains. A rough diagram has been preserved showing the disposition of the bones *in situ ;* in this it can be seen that the skull, which was present, though too comminuted and destroyed by plant roots to be capable of preservation, and the tusk, which has been preserved, all lay well to the side of the original trench. The molar teeth all lay close to the skull, and had they been second molars it is quite clear from the state of wear that the third molars would have been largely formed. In that case there would have been a large number of separate lamellae, some of which might reasonably be expected to occur. As the whole site was most carefully examined and none was found it adds to the evidence that these teeth are true third molars. If this is the case it makes the specimen a very remarkable one, in that the teeth are of such small size, hardly larger than the little form of *E. antiquus*, from Barrington, near Cambridge, while in the rest of the body it is one of the largest of known elephants. It would have been reasonable to expect a molar tooth more of the size of the large examples found on the continent (such as the Taubach form) as well as in England. There is, for instance, a lower third molar from Whittlesea mere in the Museum of Zoology at Cambridge, which though lacking some of the anterior plates measures (for 12½ plates) 336 mm. in length (Forster Cooper, 1924, pl. x, fig. 3).

The upper molars are alike, and show twelve plates with a posterior talon.* A certain number of plates, estimated at four at the most, have been worn away anteriorly. They are 221 millimeters in length, 83 in breadth, and have a maximum depth of 150. The laminar frequence † is five.

The lower molar shows a posterior talon and ten plates, a certain number must have been worn away in front. The length of the remaining part is 231 millimetres, the breadth 70, and depth 123. The laminar frequence is five, as in the upper teeth.

The enamel is fairly thick (about 4 millimetres). It is coarsely folded and without any fine secondary wrinklings. The diamond lozenges are well marked on the lower molar, less so on the upper teeth.

Summary.

It will be seen from Andrews' account, especially in the section referring to the foot bones (p. 14), that the Upnor specimen shows, when compared with other forms, a great mixture of specific characters. The femur, for example, "resembles *E. africanus* more than *E. maximus*" (p. 13), while the astragalus "on the whole is much like that of *E. maximus* and *E. primigenius*, and differs from the astragalus of *E. africanus*" (p. 15), and so on.

The general result of Andrews' detailed investigation is that in some characters the specimen resembles one form and other forms in other characters, with the result that a clear diagnosis is not possible.

It is a regrettable fact but true that, of the large number of species of elephants that have been named and described, a specimen as moderately complete even as the present one is a rare exception, and we have as yet no standard by which to judge fragments. No full investigation of the range of variation in the shape of bones and their articular facets, in variations due to sex or age, in the difference in the size of teeth, and so on, has as yet been made on the living species. That this has not been done is no doubt easily explained by the difficulty of finding a sufficient number of specimens to examine, since at least a hundred would be required; such an investigation is none the less a desideratum, and would do much to throw a useful sidelight on the vexed problem presented by the many shades of difference seen in the scattered bones and loose teeth of the numerous extinct forms.

The absence of any definite standard of comparison as well as the absence of any complete specimen of *E. antiquus* prevents us therefore from estimating the true value of the two outstanding features of this Upnor specimen, namely the

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* I use the term "talon" only when there is a part which in wear cuts as a plate of greater or lesser size, but which has no root of its own and joins the root of the preceding plate.

† *i.e.* the number of plates in a standard length of 10 centimetres. This index varies somewhat in accordance with the wear of the tooth as well as the place of measurement on the tooth surface. The unworn plates often show a higher index figure than the worn. Here the measurement is taken at the middle plates of the teeth.

curious and apparently unique upright position of the spines of the vertebral column, and the unexpectedly small size of the teeth in relation to the great bulk of the body. Should examination of further material eventually show that this form differs from the type so far as to warrant the erection of a sub-species, then it is to be hoped that the present specimen will be taken as the holotype, and that the sub-species will be named after Dr. Charles W. Andrews, who did so much to elucidate the early history of the Proboscidea.

C. FORSTER COOPER.

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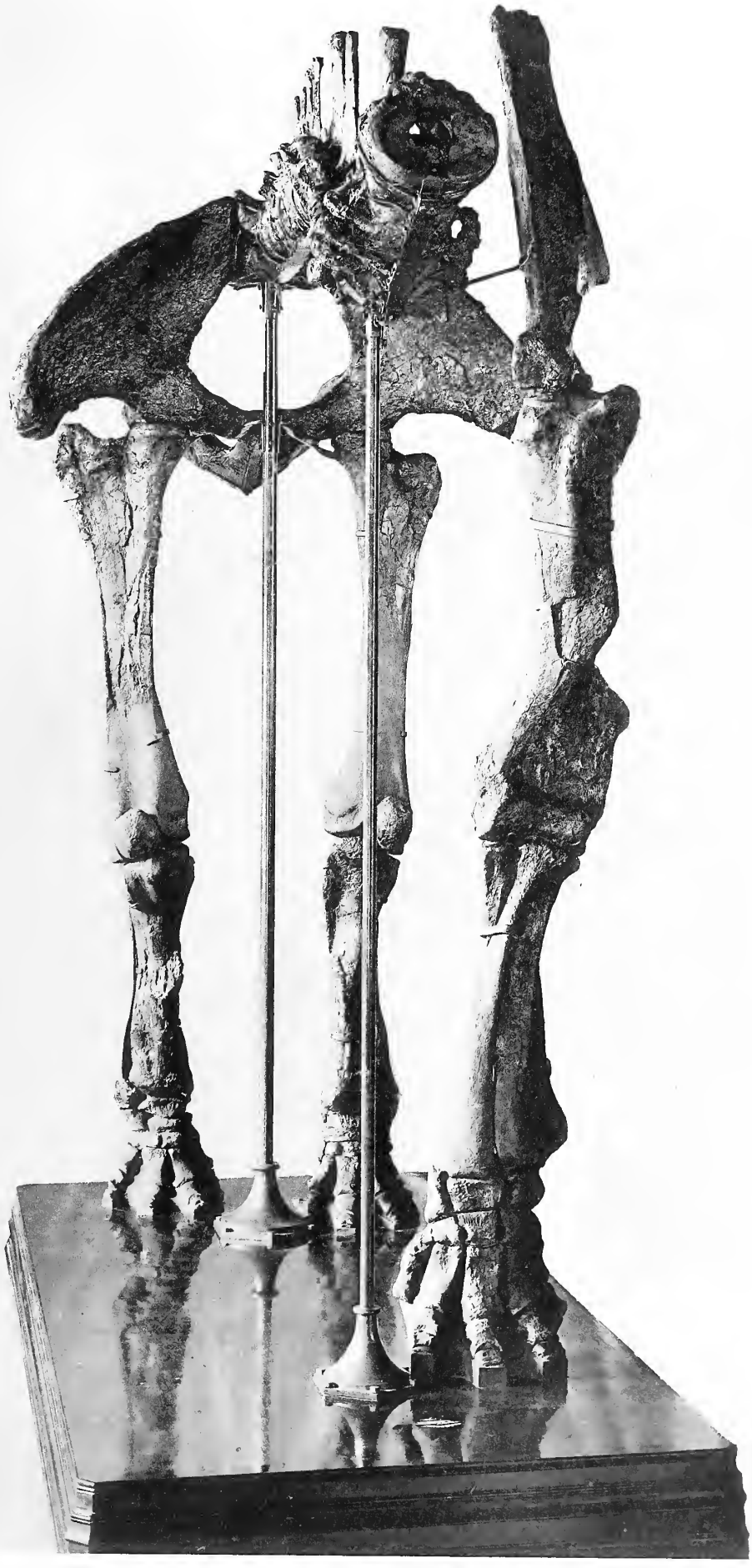
Plate I.

PLATE I.

The Upnor specimen viewed obliquely from the front.



H. G. Herring photo

C. Whittingham & Griggs Ltd Imp.

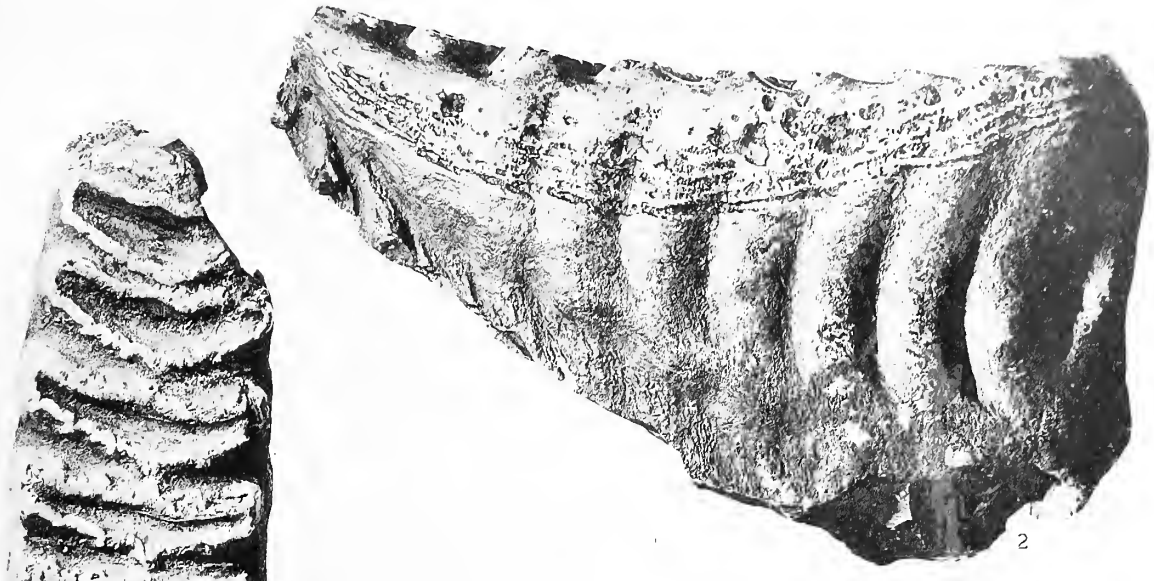
Elephas antiquus Falconer.

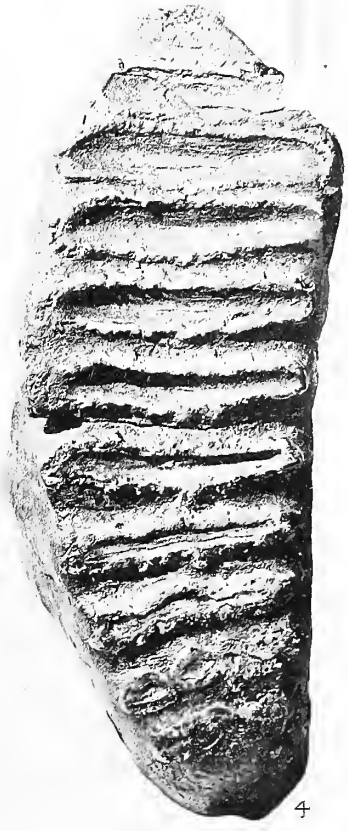
Plate II.

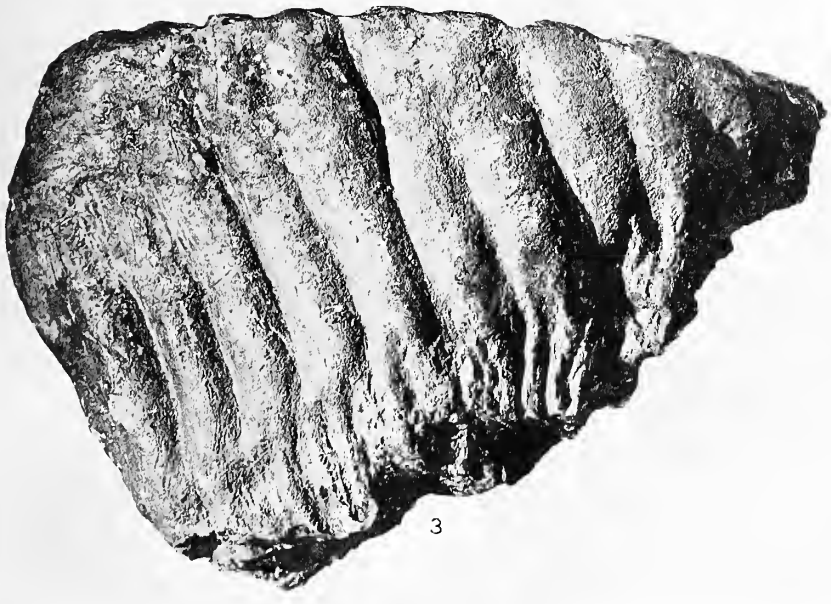
PLATE II.

Crown and side views of the upper (below) and lower (above) molars of *Elephas antiquus* from Upnor, Kent.

One-half natural size.







H. G. Herring photo

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Elephas antiquus Falconer.

Plate III.

PLATE III.

1*a*–1*d*.—Left scaphoid.
2*a*–2*d*.—Left lunar seen from above.
3*a*–3*d*.—The same seen from below.
1*a*, 2*a*, 3*a*.—*Elephas antiquus*, Falconer, Upnor specimen.
1*b*, 2*b*, 3*b*.—*Elephas primigenius*, Blumenbach.
1*c*, 2*c*, 3*c*.—*Elephas maximus* Linné.
1*d*, 2*d*, 3*d*.—*Elephas africanus* Blumenbach.
cu., cuneiform facet ; *ll.*, *ul.*, upper and lower lunar facets ; *m.*, *mag.* facet for magnum ; *r.*, radial facet ; *sc.*, scaphoid facet ; *tm.*, facet for trapezium ; *tz.*, facet for trapezoid ; *u.*, ulnar facet.
All $\frac{3}{5}$ natural size.


1A.
r.
u.l.
l.l.
m.
tz.
tm.
1B.
r.
u.l.
m.
l.l.
tz.
tm.
1C.
r.
u.l.
l.l.
m.
tz.
1D.
r.
u.l.
l.l.
m.
tz.
2A.
r
u.
2B.
r
u.
2C.
r.
u.
2D.
sc.
r.
u.
3A.
mag.
cu.
3B.
cu.
mag.
3C.
cu.
mag.
sc.
3D.
cu.
mag.

Plate IV.

PLATE IV.

a–1*d*.—Left cuneiform seen from above.
2.—Left pisiform.
3*a*–3*c*.—Left trapezium, inner face.
4*a*, 4*d*.—Left trapezoid, inner face.
4*b*, 4*c*, 4*e*.—The same seen from above.
1*a*.—*E. antiquus* Falconer, another specimen.
2, 3*a*, 4*a*, 4*b*.—*Elephas antiquus* Falconer, Upnor specimen.
1*b*.—*Elephas primigenius* Blumenbach.
1*c*, 3*b*, 4*c*.—*Elephas maximus* Linné.
1*d*, 3*c*, 4*d*, 4*e*.—*Elephas africanus* Blumenbach.
cu., cuneiform facet ; *mag.*, facet for magnum ; *mc.*, facet for metacarpal I ; *mc.2*, facet for metacarpal II ; *p.*, facet for pisiform ; *sc.*, scaphoid facet ; *tz.*, facet for trapezoid ; *u.*, ulnar facet.
All $\frac{3}{8}$ natural size.

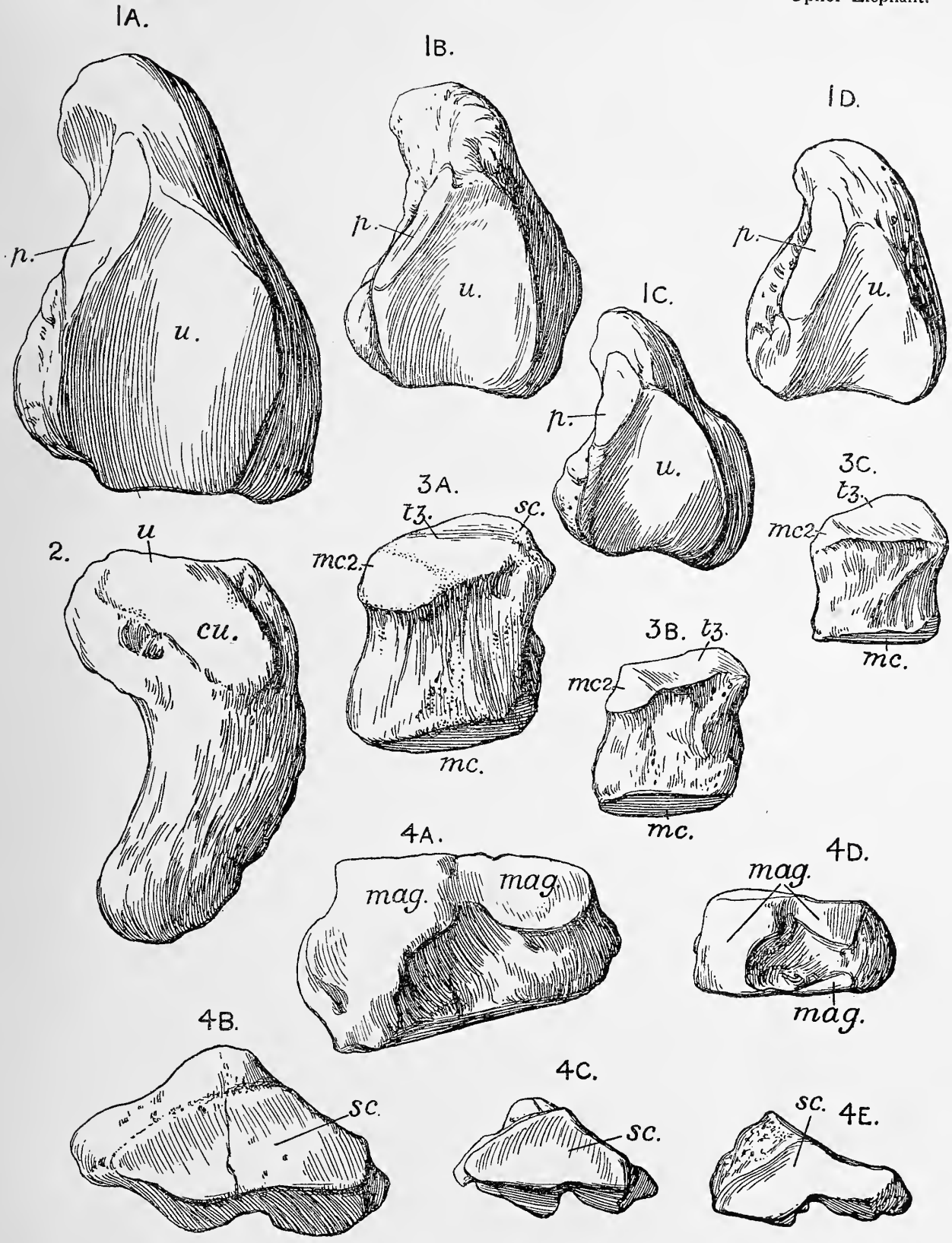

1A.
p.
u.
1B.
p.
u.
1C.
p.
u.
1D.
p.
u.
2.
u
cu.
3A.
tz.
sc.
mc2.
mc.
3B.
tz.
mc2.
mc.
3C.
tz.
mc2.
mc.
4A.
mag.
mag.
4B.
sc.
4C.
sc.
4D.
mag.
mag.
4E.
sc.

Plate V.

PLATE V.

1*a*–1*d*.—Left magnum seen from above.
2*a*–2*d*.—The same seen from below.
3*a*–3*c*.—Left unciform seen from above.
1*a*, 2*a*.—*Elephas antiquus* Falconer, Upnor specimen.
3*a*.—*E. antiquus* Falconer, another specimen ; neither unciform was found at Upnor.
1*b*, 2*b*.—*Elephas primigenius* Blumenbach.
1*c*, 2*c*, 3*b*.—*Elephas maximus* Linné.
1*d*, 2*d*, 3*c*.—*Elephas africanus* Blumenbach.
cu., cuneiform facet ; *lu.*, lunar facet ; *mc.*2, facet for metacarpal II ; *mc.*3, facet for metacarpal III ; *tz.*, facet for trapezoid.
All $\frac{3}{8}$ natural size.

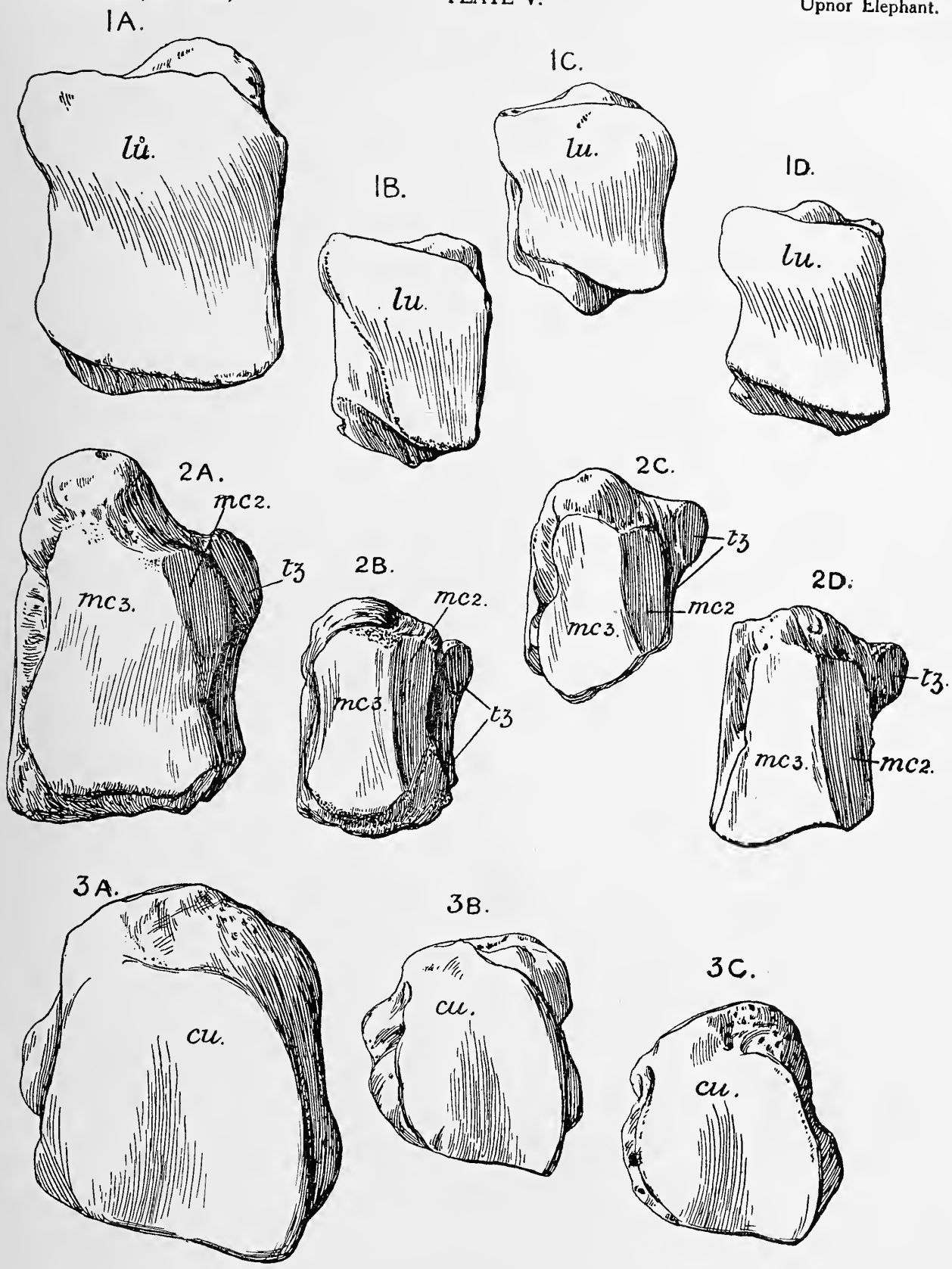

1A.
lu.
1B.
lu.
1C.
lu.
1D.
lu.
2A.
mc2.
tz
mc3.
2B.
mc2.
mc3.
tz
2C.
tz
mc2
mc3.
2D.
tz.
mc3.
mc2.
3A.
cu.
3B.
cu.
3C.
cu.

Plate VI.

PLATE VI.

1*a*–1*d*.—Left astralagus seen from above.
2*a*–2*d*.—The same seen from below.
3*a*–3*d*.—Left navicular seen from above.
4*a*–4*d*.—The same seen from below.
1*a*, 2*a*, 3*a*, 4*a*.—*Elephas antiquus* Falconer, Upnor specimen.
1*b*, 2*b*, 3*b*, 4*b*.—*Elephas primigenius* Blumenbach.
1*c*, 2*c*, 3*c*, 4*c*.—*Elephas maximus* Linné.
ast., astragalar facet ; *calc.*, calcaneal facet ; *cub.*, facet for cuboid ; *ec.*, ectal facet ; *ectc.*, facet for ectocuneiform ; *entc.*, facet for entocuneiform ; *fib.*, fibular facet ; *mesc.*, facet for mesocuneiform ; *nav.*, navicular facet ; *sus.*, sustentacular facet ; *tib.*, tibial facet.
All $\frac{3}{8}$ natural size.

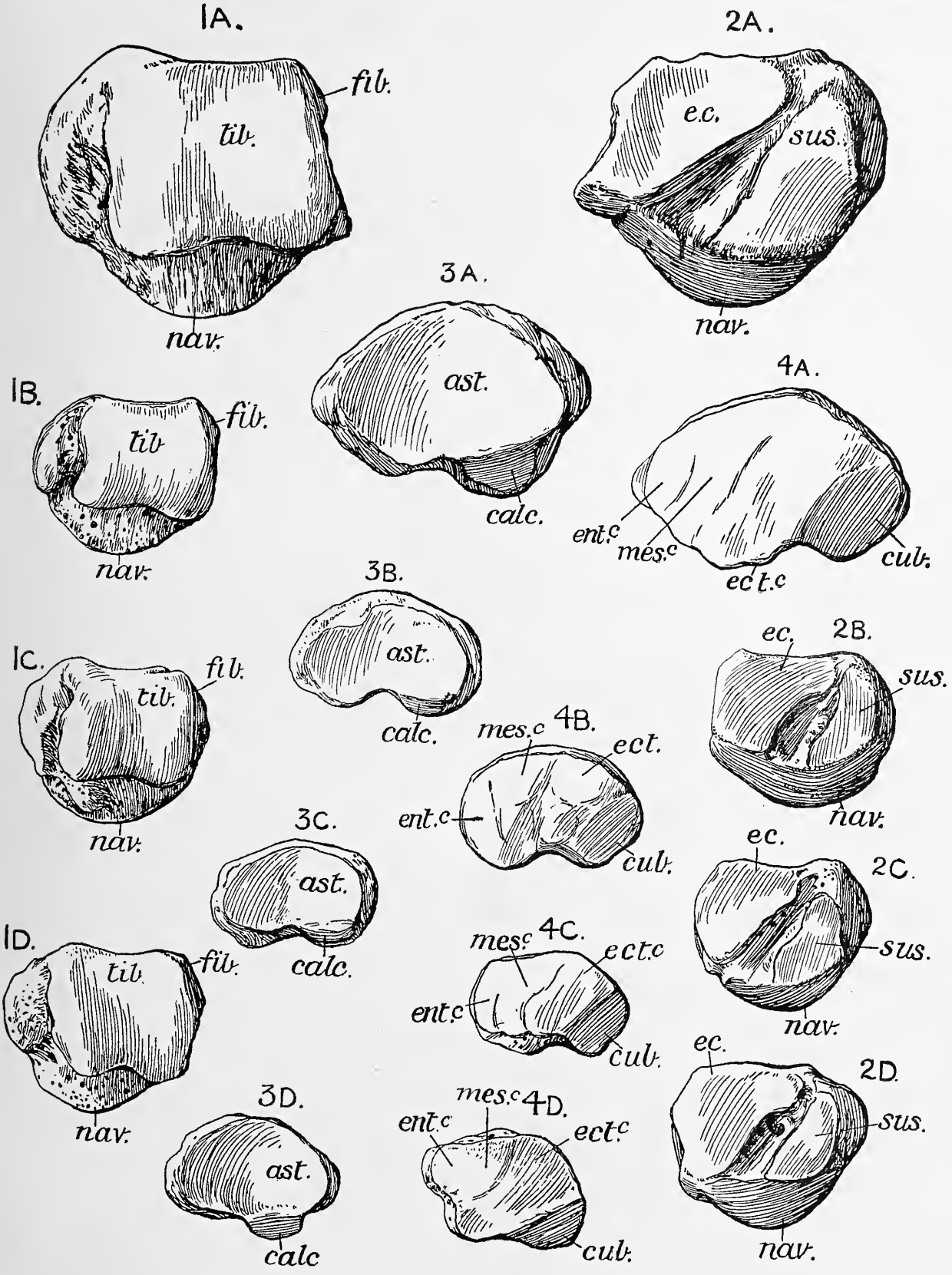

1A.
fib.
tib.
nav.
2A.
e.c.
sus.
nav.
3A.
ast.
calc.
1B.
fib.
tib
nav.
4A.
ent.c
mes.c
ect.c
cul.
3B.
ast.
calc.
1C.
fib.
tib.
nav.
mes.c
4B.
ect.
ent.c
cul.
ec.
2B.
sus.
nav.
3C.
ast.
calc.
ec.
2C.
sus.
nav.
1D.
tib.
fib.
nav.
mes.c
4C.
ect.c
ent.c
cul.
3D.
ast.
calc
mes.c
ent.c
4D.
ect.c
cul.
ec.
2D.
sus.
nav.

Plate VII.

PLATE VII.

1*a*–1*d*.—Left calcaneum seen from the front.
2*a*–2*d*.—The same seen from the right side.
1*a*, 2*a*.—*Elephas antiquus* Falconer, Upnor specimen.
1*b*, 2*b*.—*Elephas primigenius* Blumenbach.
1*c*, 2*c*.—*Elephas maximus* Linné.
1*d*, 2*d*.—*Elephas africanus* Blumenbach.
cub., facet for cuboid ; *ect*., ectal facet ; *fib*., fibular facet ; *sus*., sustentaculum tali ; *t.c*., tuber calcis.
All $\frac{3}{8}$ natural size.

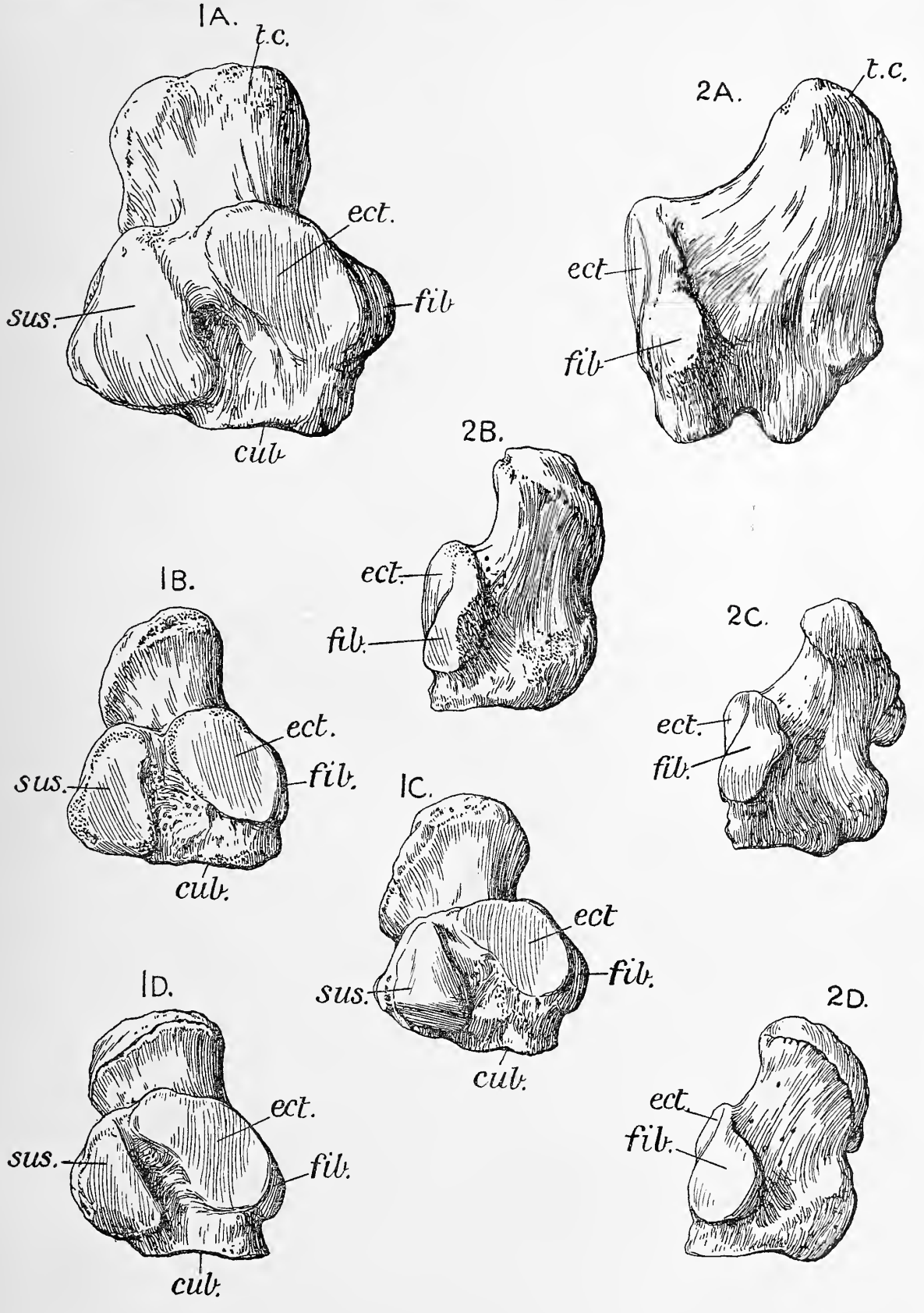

1A.
t.c.
ect.
fib.
sus.
cub.
2A.
t.c.
ect
fib.
2B.
ect.
fib.
1B.
ect.
sus.
fib.
cub.
2C.
ect.
fib.
1C.
ect
sus.
fib.
cub.
1D.
ect.
sus.
fib.
cub.
2D.
ect.
fib.

Plate VIII.

PLATE VIII

1*a*–1*c*.—Left cuboid seen from below.

2*a*–2*c*.—The same seen from above.

3*a*–3*c*.—Left ectocuneiform seen from below.

4*a*.—Left metacarpals II, III, IV, seen from above.

4*b*.—The same seen from the front.

1*a*, 2*a*, 3*a*, 4*a*, 4*b*.—*Elephas antiquus* Falconer, Upnor specimen.

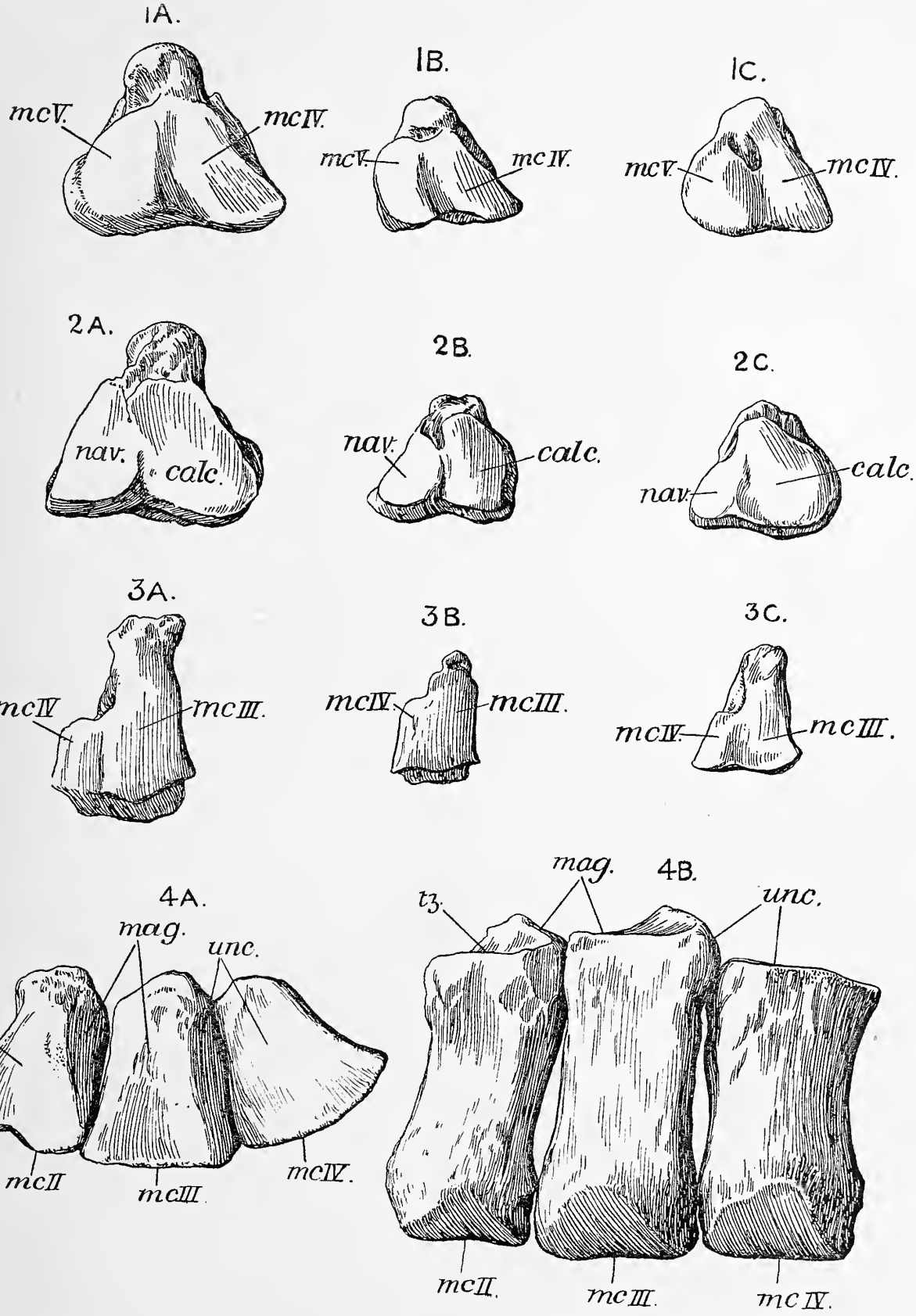
1*b*, 2*b*, 3*b*.—*Elephas maximus* Linné.

3*a*, 3*b*, 3*c*.—*Elephas africanus* Blumenbach.

calc., calcaneal facet ; *mag.*, facet for magnum ; *nav.*, navicular facet ; *tz.*, facet for trapezoid ; *unc.*, facet for unciform.

NOTE.—*mc. III, IV, V* in figs. 1*a*–1*c* and 3*a*–3*c* indicate the facet for articulation with metatarsals III–V, the contraction *mc.* being an error. *mc. II, III, IV* in figs. 4*a*, 4*b* indicate metacarpals II, III, IV.

All $\frac{3}{8}$ natural size.


1A.
mcV.
mcIV.
1B.
mcV.
mcIV.
1C.
mcV.
mcIV.
2A.
nav.
calc.
2B.
nav.
calc.
2C.
calc.
nav.
3A.
mcIV
mcIII.
3B.
mcIV.
mcIII.
3C.
mcIV.
mcIII.
4A.
mag.
unc.
t3.
mcII
mcIII.
mcIV.
mag.
4B.
t3.
unc.
mcII.
mcIII.
mcIV.